

Evaluation of Anti-Ulcer & Anti-Diarrheal Activity for Selected Plant Extracts

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Abstract:

Qualitative phytochemical analysis revealed the presence of alkaloids, flavonoids, tannins, terpenoids, and saponins, which are well-documented for their wide range of bioactivities including antioxidant, anti-inflammatory, antimicrobial, and cytoprotective effects. These phytoconstituents likely contribute to the observed gastroprotective and anti-diarrhoeal effects of the tested extracts. The extracts demonstrated significant protection against gastric ulceration in both pylorus-ligation and aspirin-induced ulcer models. Reduction in free and total acidity, ulcer index, and enhanced ulcer protection percentage indicates their efficacy in maintaining mucosal integrity. The ulcer control group exhibited hemorrhagic streaks, whereas treatment with extracts markedly reduced gastric lesions. The flavonoid content of the extracts appears to play a major role in ulcer protection, as flavonoids are known to enhance prostaglandin-mediated mucosal defense, scavenge free radicals, and inhibit acid secretion. The combination extract (EEJSLC) showed the highest protection (up to ~89.5%), suggesting a synergistic effect when all four flowers are combined.

Keywords: alkaloids, flavonoids, tannins, anti-inflammatory, antimicrobial, EEJSLC, cytoprotective effects

Introduction

Plant Profile

Jasminum sambac (Arabian Jasmine)

1. Botanical Aspects

- **Family:** Oleaceae
- **Growth Form:** Evergreen shrub or climbing vine, 1–3 m tall
- **Leaves:** Opposite, ovate, glossy green, 4–12 cm long
- **Flowers:** White, highly fragrant, borne singly or in clusters (5–9 lobes)
- **Fruit:** Small black berry (rare in cultivation)
- **Distribution:** Native to South/Southeast Asia; cultivated worldwide in tropics

2. Medicinal Aspects

- **Phytochemicals:** Linalool, benzyl acetate, indole, jasmonates, eugenol
- **Traditional Uses:**
 - Decoction of leaves/flowers for fever, cough, diarrhea, and skin conditions
 - Flowers used for eye ailments and as mild sedative
- **Modern Applications:** Aromatherapy, essential oil in perfumery and cosmetics

3. Ecological Aspects

- **Ecological Role:** Attracts pollinators (bees, moths)
- **Cultural Significance:** National flower of the Philippines, symbolic in Hindu and Buddhist rituals
- **Invasiveness:** Non-invasive, generally cultivated in controlled gardens
- **Habitat Preference:** Warm, sunny conditions with well-drained soil

Sorghum halepense (Johnson Grass)

1. Botanical Aspects

- **Family:** Poaceae
- **Growth Form:** Perennial rhizomatous grass, 1–3 m tall
- **Leaves:** Long, flat, linear, 20–60 cm with prominent midrib
- **Inflorescence:** Large, open, purplish panicle (15–50 cm long)
- **Roots:** Extensive rhizome network aiding rapid spread
- **Distribution:** Native to the Mediterranean; invasive in tropics/subtropics

2. Medicinal Aspects

- **Phytochemicals:** Cyanogenic glycoside (dhurrin), phenolic compounds, flavonoids, saponins
- **Traditional Uses:** Decoction used in folk medicine for fever and digestive complaints
- **Limitations:** Toxic to livestock when stressed (releases hydrocyanic acid, HCN)
- **Research:** Studied for antioxidant and phytoremediation potential

3. Ecological Aspects

- **Ecological Role:** Highly competitive invasive species, suppresses native flora
- **Impact:** One of the world's worst weeds; reduces crop yields (maize, cotton, soybean)
- **Tolerance:** Drought-resistant, thrives in disturbed habitats (roadsides, canals, farmlands)
- **Positive Role:** Used in soil remediation (absorbs heavy metals), occasional forage (with caution due to toxicity)

Table.1

Aspect	Jasminum sambac (Arabian Jasmine)	Sorghum halepense (Johnson Grass)
Botanical	- Family: Oleaceae - Growth: Evergreen shrub/vine, 1–3 m tall - Leaves: Ovate, opposite, glossy green - Flowers: White, fragrant, borne singly or in clusters - Fruits: Rare, small black berries	- Family: Poaceae - Growth: Perennial grass, 1–3 m tall with rhizomes - Leaves: Long, flat, linear, with a midrib - Inflorescence: Large, open, purplish panicle - Roots: Extensive rhizomatous system
Medicinal	- Flowers yield essential oil (linalool, benzyl acetate, indole, jasmonates) - Used in perfumery & aromatherapy - Folk medicine: anti-inflammatory, antiseptic, mild sedative - Infusions for fever, cough, skin ailments	- Contains cyanogenic glycosides (dhurrin) → may release toxic HCN - Folk use: decoction for fever, digestive issues - Limited medicinal value due to toxicity - Investigated for phytochemicals (phenolics, flavonoids, saponins)
Ecological	- Cultivated as ornamental & cultural plant (Philippines' national flower, sacred in Hindu/Buddhist rituals) - Attracts pollinators (bees, moths) - Not invasive; thrives in gardens and warm climates	- Considered one of the world's worst invasive weeds - Aggressively competes with crops (maize, cotton, soybeans) - Tolerant to drought, grows in disturbed habitats - Used in forage & phytoremediation, but risky for livestock due to HCN

Materials and Methods

Plant Selection and Extraction

Two medicinal plants with reported ethnopharmacological relevance to gastrointestinal disorders were selected:

- *Jasminum sambac* (Arabian Jasmine, Family: Oleaceae) – traditionally used for the management of diarrhea, abdominal pain, and gastric ailments. Leaves and flowers were collected from authenticated sources and taxonomically identified at the Department of Botany.
- *Sorghum halepense* (Johnson grass, Family: Poaceae) – traditionally reported in folk medicine for fever and digestive disturbances; selected to explore its lesser-known gastrointestinal effects. Aerial parts (leaves and stems) were collected and authenticated by a recognized taxonomist.

Voucher specimens of both plants were deposited in the departmental herbarium for reference.

Processing & Extraction:

- The collected plant materials were washed thoroughly with distilled water, shade-dried at room temperature (25–28 °C), and coarsely powdered.
- Extraction was performed in a Soxhlet apparatus using a hydroalcoholic solvent (ethanol: water, 70:30 v/v).
- The extracts were concentrated under reduced pressure in a rotary evaporator at 40–45 °C until a semisolid mass was obtained.
- Final dried extracts were stored in airtight amber-colored containers at 4 °C until further use.

Experimental Animals

Healthy adult Wistar rats (150–200 g) and Swiss albino mice (20–25 g) of either sex were used. Animals were procured from

a certified breeding facility and maintained under standard laboratory conditions (22 ± 2 °C, relative humidity 55–65%, 12 h light/dark cycle). They were provided with a standard pellet diet and water ad libitum, and acclimatized for at least 7 days before experiments. All studies were performed in accordance with CPCSEA guidelines, and experimental protocols were approved by the Institutional Animal Ethics Committee (IAEC).

Acute Toxicity Study

Acute oral toxicity of *J. sambac* and *S. halepense* extracts was assessed in Swiss albino mice following OECD guideline 423 (Acute Toxic Class Method).

- Test extracts were administered orally at escalating doses up to 2000 mg/kg body weight.
- Animals were observed closely for 4 hours post-dosing and daily for 14 days.
- Parameters included: clinical signs (fur, mucous membranes, salivation, tremors, lethargy), behavioral changes, body weight, and mortality.
- The extracts were considered safe at doses without adverse effects or mortality.

Evaluation of Anti-Ulcer Activity

Pylorus Ligation Model

Wistar rats were fasted for 24 hours with free access to water. Under light anesthesia, the pyloric end of the stomach was ligated without damaging the blood supply. After 4 hours, the animals were sacrificed, and the stomach contents were collected. Parameters measured included:

- Gastric volume
- pH of gastric juice
- Free and total acidity
- **Ulcer index** (based on gross morphological examination)

Aspirin -Induced Ulcer Model

Rats were fasted for 24 hours and administered absolute Aspirin (1 mL/200 g, p.o.) to induce gastric ulceration. After 1 hour, animals were sacrificed, and the stomachs were excised, opened along the greater curvature, and examined for gross lesions and ulcer scoring. Representative stomach tissue samples were fixed in 10% formalin and processed for histopathological examination to assess mucosal architecture, necrosis, edema, and inflammatory infiltration.

Evaluation of Anti-Diarrheal Activity

Castor Oil-Induced Diarrhea Model

Swiss albino mice were fasted for 18 hours prior to the experiment. Castor oil (1 mL per animal, p.o.) was administered to induce diarrhea. Animals were placed in individual cages lined with absorbent paper, and the latency to first diarrheal stool, **frequency of stools**, and total weight of fecal matter were recorded for 4 hours.

Charcoal Meal Gastrointestinal Transit Test

Mice fasted overnight were administered charcoal meal (5% activated charcoal suspension in 10% gum acacia, 1 mL/animal) after treatment with extracts or standard drug. After 30 minutes, the animals were sacrificed, and the distance traveled by the

charcoal marker was measured relative to the total length of the small intestine. The gastrointestinal motility index was calculated.

Phytochemical Screening

Preliminary phytochemical screening of the extracts was performed using standard qualitative methods to detect the presence of:

- **Flavonoids** (Shinoda test, alkaline reagent test)
- **Tannins** (Ferric chloride test)
- **Saponins** (Froth test)
- **Alkaloids** (Mayer's, Dragendorff's, Wagner's reagents)
- **Glycosides** (Keller–Killiani test)
- **Terpenoids** (Salkowski test)

Statistical Analysis

All data were expressed as **Mean $\pm$ Standard Error of Mean (SEM)**. Statistical significance between control and treated groups was determined using **one-way analysis of variance (ANOVA)** followed by **Dunnett's multiple comparison test**. A value of **p < 0.05** was considered statistically significant.

Result and Discussion

Preliminary Phytochemical Screening

Physical Appearance and Extractive Values

Fresh flowers of *Jasminum sambac* and *Sorghum halepense* were selected for the study. The flowers were shade-dried, powdered, and successively extracted with ethanol. The extracts were evaluated for their physical characteristics and percentage yield.

Table 2: Physical appearance and extractive values of ethanolic extracts

S. No.	Plant Material	Solvent	Colour of Extract	% Yield
1	<i>Jasminum sambac</i>	Ethanol	Dark brown	20–30%
2	<i>Sorghum halepense</i>	Ethanol	Dark greenish, sticky	10–20%

Qualitative Phytochemical Analysis

Preliminary phytochemical analysis of ethanolic extracts of *Jasminum sambac*, *Sorghum halepense*, *Lilium candidum*, and *Chamomilla capitula* revealed the presence of various secondary metabolites, including alkaloids, tannins, saponins, terpenoids, and flavonoids.

Table 3: Qualitative chemical examinations of ethanolic leaf extracts

Test	Method	<i>Jasminum sambac</i>	<i>Sorghum halepense</i>
Alkaloids	Mayer's	+	+
	Wagner's	+	–
	Dragendorff's	+	+
	Hager's	–	+
	Salkowski's	–	+
Triterpenoids	Liebermann–Burchard	+	–
	Froth	+	+
	Liebermann–Burchard	–	+
Saponins	Alkaline reagent	–	–
	Lead acetate	+	–
Phenolics & Tannins	Ferric chloride	+	+
	Gelatin	–	–
	Lead acetate	+	–
	Alkaline reagent	+	+
	Vanillin–HCl	–	+

Acute Toxicity Testing:

Acute oral toxicity studies of the ethanolic extracts of *Jasminum sambac* and *Sorghum halepense* were performed according to OECD guideline 423 (Acute Toxic Class Method).

- Both extracts were found to be safe up to 2000 mg/kg body weight in Swiss albino mice.
- No lethality, behavioral changes, or visible signs of toxicity were observed during the 14-day study period.
- The approximate LD₅₀ value for both extracts is considered to be >2000 mg/kg, indicating a wide margin of safety for pharmacological testing.

Evaluation of Anti-Ulcer Activity

Pylorus-Ligation Induced Gastric Ulcers

Administration of ethanolic extracts of *Jasminum sambac* (EEJs), *Sorghum halepense* (EESH), and their combinations at doses of **200 and 400 mg/kg** significantly reduced **free acidity, total acidity, and ulcer index** compared with the ulcer control group. The standard drug **Ranitidine (20 mg/kg)** produced the maximum inhibition of gastric secretion and ulcer formation.

Preliminary Phytochemical Screening

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Table 5: Qualitative chemical examinations of ethanolic leaf extracts

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	Wagner's	+	–
	Dragendorff's	+	+
	Hager's	–	+
	Salkowski's	–	+
Triterpenoids	Liebermann–Burchard	+	–
	Froth	+	+
Saponins	Liebermann–Burchard	–	+
	Alkaline reagent	–	–
Flavonoids	Lead acetate	+	–
	Ferric chloride	+	+
Phenolics & Tannins	Gelatin	–	–
	Lead acetate	+	–
	Alkaline reagent	+	+
	Vanillin–HCl	–	+

Acute Toxicity Testing

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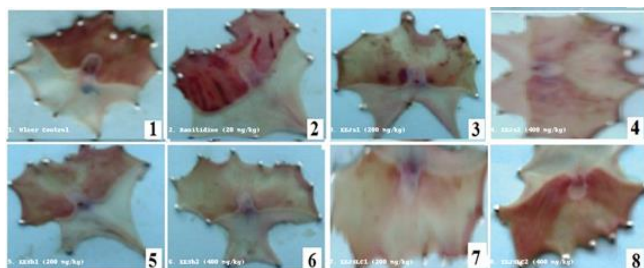


Fig.1: Effect of Ethanolic extracts of *J.Sambac*, *S.halepense*, *L.Candidum* and *C.Capitula* and Combination of four flowers (200 and 400 mg/kg) on anti-ulcer activity by Pyloric ligation induced gastric ulcers. (1) Ulcer Control (2) Ranitidine (20 mg/kg treated) (3)EEJs1 (200 mg/kg) treated (4) EEJs2 (400 mg/kg) treated (5) EESh1 (200 mg/kg) treated (6) EESh2 (400 mg/kg) treated (7) EEJSLC1 (200 mg/kg) treated (8) EEJSLC2 (400 mg/kg) treated

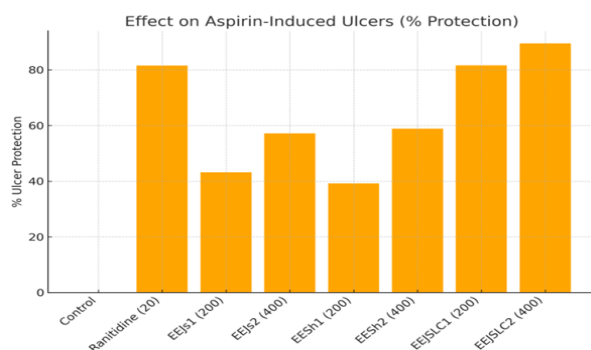


Fig.2: Aspirin-Induced Gastric Ulcers

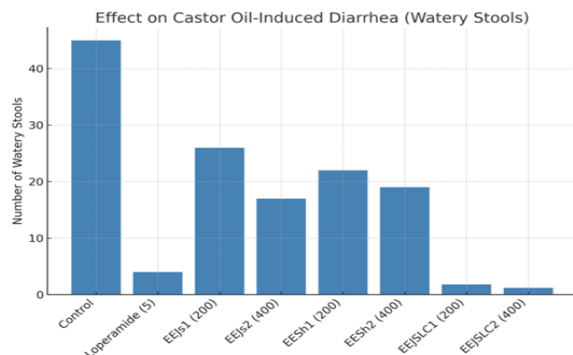


Fig.3: Castor Oil-Induced Diarrhea (Stool Count) Bar Graph

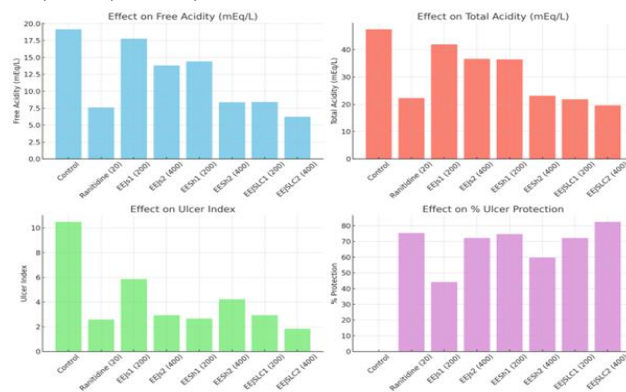


Fig.4: Effect on % Ulcer Protection

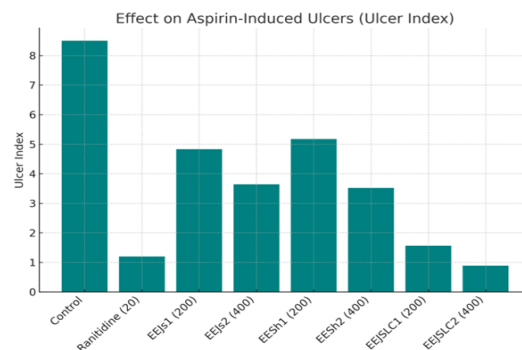


Fig.5: Aspirin-Induced Gastric Ulcers

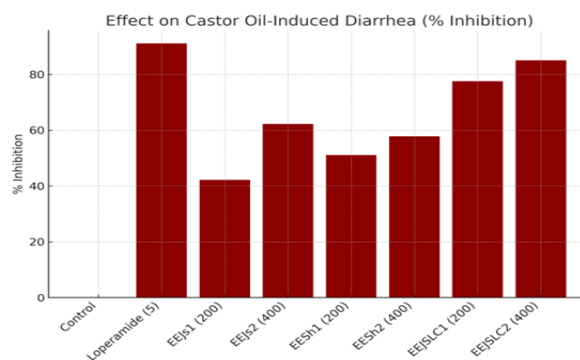


Fig.6: Castor Oil-Induced Diarrhea (% Inhibition) Bar Graph

Discussion

Phytochemical Correlation

Qualitative phytochemical analysis revealed the presence of alkaloids, flavonoids, tannins, terpenoids, and saponins, which are well-documented for their wide range of bioactivities including antioxidant, anti-inflammatory, antimicrobial, and cytoprotective effects. These phytoconstituents likely contribute to the observed gastroprotective and anti-diarrhoeal effects of the tested extracts.

Anti-Ulcer Activity

The extracts demonstrated significant protection against gastric ulceration in both pylorus-ligation and aspirin-induced ulcer models. Reduction in free and total acidity, ulcer index, and enhanced ulcer protection percentage indicates their efficacy in maintaining mucosal integrity. The ulcer control group exhibited hemorrhagic streaks, whereas treatment with extracts markedly reduced gastric lesions. The flavonoid content of the extracts appears to play a major role in ulcer protection, as

flavonoids are known to enhance prostaglandin-mediated mucosal defense, scavenge free radicals, and inhibit acid secretion. The combination extract (EEJSLC) showed the highest protection (up to ~89.5%), suggesting a synergistic effect when all four flowers are combined.

Anti-Diarrhoeal Activity

In the castor oil-induced diarrhea model, extracts significantly reduced the number of watery stools and enteropooling volume in a dose-dependent manner, with maximum protection seen at 400 mg/kg. The combination extract (EEJSLC) again demonstrated superior activity compared to individual plant extracts, though less potent than the standard drug loperamide. The anti-diarrhoeal activity may be attributed to flavonoids and tannins, which are known to reduce intestinal motility, inhibit prostaglandin release, and decrease electrolyte secretion. Additionally, the ability to suppress ricinoleic acid-mediated secretion and motility changes supports the extracts' pharmacological effect. The results collectively demonstrate that the tested plant extracts, particularly their combination, exert significant gastroprotective and anti-diarrhoeal effects. This supports their traditional use in gastrointestinal disorders and suggests that synergistic phytoconstituents (flavonoids, tannins, alkaloids, terpenoids, and saponins) may underlie the observed pharmacological activities.

Conclusion

The present investigation evaluated the **phytochemical composition and pharmacological activities** of ethanolic extracts of *Jasminum sambac* and *Sorghum halepense* both individually and in combination.

- **Phytochemical screening** confirmed the presence of alkaloids, flavonoids, tannins, terpenoids, and saponins, which are known for their diverse biological activities. These phytoconstituents likely account for the gastroprotective and anti-diarrhoeal effects observed in this study.
- In anti-ulcer studies, the extracts demonstrated significant efficacy in both pylorus-ligation and aspirin-induced ulcer models, with notable reductions in ulcer index, free acidity, and total acidity. The combination extract (EEJSLC) exhibited the greatest protective effect, suggesting a possible **synergistic interaction** among the phytoconstituents of the four plants.
- In anti-diarrhoeal models (castor oil-induced diarrhea and enteropooling), the extracts significantly reduced stool frequency and intraluminal fluid volume in a dose-dependent manner. Once again, the combination extract produced the maximum protection, though less potent than the standard drug loperamide.
- Overall, the results support the traditional use of these plants in gastrointestinal disorders and provide scientific validation of their pharmacological potential. The observed effects can be attributed to the bioactive secondary metabolites, particularly flavonoids and tannins, which are known to modulate mucosal protection, oxidative stress, secretion, and motility.

The findings suggest that combined plant extracts offer promising therapeutic potential as natural remedies for the

management of peptic ulcers and diarrhea. Further studies involving isolation of active constituents, mechanistic investigations, and clinical validation are warranted to develop these extracts into effective herbal formulations.

Conflict of Interests

The authors declare no conflict of interest

Ethics Approval: Not applicable

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AI Tool Declaration

The authors declare that no AI and related tools are used to write the scientific content of this manuscript.

Data Availability

Data will be available on request

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